Year: 2019

The Effect of Aging on Pacing Strategies in Short and Long Distance Duathlon

Nikolaidis, Pantelis T ; Villiger, Elias ; Victor Sousa, Caio ; Rosemann, Thomas ; Knechtle, Beat

Abstract: Background/Study context: Many studies have been conducted on the triathlon during the last several years; however, less information exists with regards to duathlon (i.e., Run 1, Bike and Run 2). The aim of the present study was to examine the effect of age on pacing (i.e., the relative contribution - % - of each discipline and transition times - Transition 1 and Transition 2 - to overall race time) of duathletes competing either to short (i.e., 10 km Run 1, 50 km Bike and 5 km Run 2) or long distance (i.e., 10 km Run 1, 150 km Bike and 30 km Run 2). METHODS We analyzed 6,671 finishes (women's, n= 1,037, age 36.6 ± 9.1 years; men's, n= 5,634, 40.0 ± 10.0 years) of 3,881 duathletes competing in 'Powerman Zofingen', the World Championship, from 2003 to 2017, in both the short and the long distance race. RESULTS A large discipline×distance interaction on relative time (%) was observed in the short distance ($p < .001$, $\eta = .936$); 24.7%, 57.4%, and 15.8% were spent in Run 1, Bike, and Run 2, respectively. In the long distance, the relative contribution of disciplines was 8.0%, 59.0%, and 32.1%, respectively. A trivial discipline×sex interaction on relative time (%) was shown in the short ($p < .001$, $\eta = .007$) and long distance ($p < .001$, $\eta = .016$). In the short distance, a small discipline×age group interaction on relative time (%) was found ($p < .001$, $\eta = .030$) with younger age groups spending less time (%) in Run 1, Transition 1 and Transition 2, and older groups less time (%) in Bike and Run 2. In the long distance, a moderate discipline×age group interaction on relative time (%) was observed ($p < .001$, $\eta = .077$) with younger age groups spending less time (%) in Run 1, Transition 1, Transition 2 and Run 2, and older groups less time (%) in Bike. CONCLUSIONS These findings suggest that younger duathletes are relatively faster in Run 1 and transitions, and older duathletes in Bike in both distances. However, older duathletes are relatively faster in Run 2 in the short distance and younger duathletes are relatively faster in Run 2 in the long distance. The magnitude of the combined effect of discipline and age group on pacing was larger in the long than in the short distance. Therefore, athletes and coaches should be aware of the variation of pacing by age group and distance of a duathlon race such as 'Powerman Zofingen'.

DOI: https://doi.org/10.1080/0361073X.2019.1609167

Originally published at:
Nikolaidis, Pantelis T; Villiger, Elias; Victor Sousa, Caio; Rosemann, Thomas; Knechtle, Beat (2019). The Effect of Aging on Pacing Strategies in Short and Long Distance Duathlon. Experimental Aging Research, 45(3):223-233.
DOI: https://doi.org/10.1080/0361073X.2019.1609167

The effect of aging on pacing strategies in short and long distance duathlon

Running head: ***Aging and pacing in duathlon***

Pantelis T. Nikolaidis[1,2], Elias Villiger[3], Caio Victor Sousa[4],
Thomas Rosemann[3], Beat Knechtle[3,5]

[1]Faculty of Biomedical Sciences, University of West Attica, Egaleo, Greece
[2]Exercise Testing Laboratory, Hellenic Air Force Academy, Acharnes, Greece
[3]Institute of Primary Care, University of Zurich, Zurich, Switzerland
[4]Graduate Program in Physical Education, Catholic University of Brasília, Brasília, Brazil
[5]Medbase St. Gallen Am Vadianplatz, St. Gallen, Switzerland

*Corresponding author
Prof. Dr. med. Beat Knechtle
Medbase St. Gallen Am Vadianplatz
Vadianstrasse 26
9001 St. Gallen
Switzerland
Telefon +41 (0) 71 226 93 00
Telefax +41 (0) 71 226 93 01
E-Mail beat.knechtle@hispeed.ch

Abstract

Background/Study context: Many studies have been conducted on the triathlon during the last several years; however, less information exists with regards to duathlon (*i.e.,* Run 1, Bike and Run 2). The aim of the present study was to examine the effect of age on pacing (*i.e.,* the relative contribution - % - of each discipline and transition times - Transition 1 and Transition 2 - to overall race time) of duathletes competing either to short (*i.e.,* 10km Run 1, 50km Bike and 5km Run 2) or long distance (*i.e.,* 10km Run 1, 150km Bike and 30km Run 2).

Methods: We analyzed 6,671 finishes (women's, n=1,037, age 36.6±9.1 years; men's, n=5,634, 40.0±10.0 years) of 3,881 duathletes competing in 'Powerman Zofingen', the World Championship, from 2003 to 2017, in both the short and the long distance race.

Results: A large discipline×distance interaction on relative time (%) was observed in the short distance ($p<.001$, $\eta^2_p=.936$); 24.7%, 57.4% and 15.8% was spent in Run 1, Bike and Run 2, respectively. In the long distance, the relative contribution of disciplines was 8.0%, 59.0% and 32.1%, respectively. A trivial discipline×sex interaction on relative time (%) was shown in the short ($p<.001$, $\eta^2_p=.007$) and long distance ($p<.001$, $\eta^2_p=.016$). In the short distance, a small discipline×age group interaction on relative time (%) was found ($p<.001$, $\eta^2_p=.030$) with younger age groups spending less time (%) in Run 1, Transition 1 and Transition 2, and older groups less time (%) in Bike and Run 2. In the long distance, a moderate discipline×age group interaction on relative time (%) was observed ($p<.001$, $\eta^2_p=.077$) with younger age groups spending less time (%) in Run 1, Transition 1, Transition 2 and Run 2, and older groups less time (%) in Bike.

Conclusions: These findings suggest that younger duathletes are relatively faster in Run 1 and transitions, and older duathletes in Bike in both distances. However, older duathletes are relatively faster in Run 2 in the short distance and younger duathletes are relatively faster in

Run 2 in the long distance. The magnitude of the combined effect of discipline and age group on pacing was larger in the long than in the short distance. Therefore, athletes and coaches should be aware of the variation of pacing by age group and distance of a duathlon race such as ‘Powerman Zofingen’.

Keywords: aging, cycling, master athletes, running, ultra-endurance

Introduction

Aging is a natural biological process characterized by cell deterioration and consequently tissue function loss (Sousa-Victor, Garcia-Prat, Serrano, Perdiguero, & Munoz-Canoves, 2015) that can affect physical performance differently depending on the sport. For instance, athletes running in sprint events reach the peak of performance between 20 to 25 years old, whereas in endurance events, the peak of performance is after 25 years old (Allen & Hopkins, 2015; Berthelot et al., 2012). In addition to sport performance, pacing - which is a correlate of performance (Abbiss & Laursen, 2008) - has been shown to be influenced by aging in various endurance sports (*e.g.* marathon running, cross-country skiing), with older athletes presenting a more even pacing than their younger counterparts (Nikolaidis et al., 2018; Nikolaidis & Knechtle, 2018).

Pacing in endurance performance describes how an athlete distributes work and energy throughout an exercise task and the strategy chosen for how an athlete paces the components of a race can have a significant impact on performance (Abbiss & Laursen, 2008). To date, six different pacing strategies have been identified such as negative, all-out, positive, even, parabolic-shaped and variable pacing strategies (Abbiss & Laursen, 2008). In the context of a race, a negative pacing occurs when the athlete increases speed across race, whereas a positive pacing refers to the opposite trend.

In multi-sports disciplines such as the triathlon (*i.e.,* swimming, cycling, and running), the pacing of athletes has been investigated for different distances such as the sprint distance triathlon (Taylor & Smith, 2014; Wu et al., 2015; Wu et al., 2016), Olympic distance, half-Ironman (Stones & Hartin, 2017; Wu et al., 2015), Ironman triathlon (Angehrn, Rüst, Nikolaidis, Rosemann, & Knechtle, 2016; Johnson et al., 2015), and longer triathlon distances (Herbst et al., 2011; Knechtle & Nikolaidis, 2016). In contrast to triathlon, where pacing has been well studied, we have no knowledge of how athletes pace during their races in duathlon (*i.e.* running, cycling, and running).

An important aspect in pacing is the age of the athletes (Nikolaidis & Knechtle, 2018). Since age is related to morphological and physiological adaptations that could affect the energy contribution during a race (Berthelot et al., 2012) the pacing strategy for a young and an older athlete with similar goals could be different. For instance, recent studies in marathoners found that fast master runners (*i.e.,* runners older than 35 years) pace differently than slow master runners (Nikolaidis & Knechtle, 2017a). Also, older runners with a similar race time as younger runners pace differently with smaller changes during the race (Nikolaidis & Knechtle, 2017b). Different from a triathlon, duathlon includes a running leg prior to the cycling and a second running leg after the cycling. This difference between triathlon and duathlon can dramatically change pace strategy to achieve an optimal performance. However, there is no evidence to illustrate the effect of age on pacing strategies used in the duathlon.

Therefore, the aim of the present study was to investigate the effect of age on pacing in duathletes and to compare between short- and long-distance duathletes. Based upon previous findings for marathon runners we hypothesize that younger athletes will adopt a more aggressive (*i.e.,* less even) pacing strategy and older athletes maintain a more stable and conservative (*i.e.,* more even) pace throughout the race.

Materials and methods

Ethical approval

The Institutional Review Board of Kanton St. Gallen, Switzerland approved all procedures used in the study with a waiver of the requirement for informed consent of the participants given the fact that the study involved the analysis of publicly available data. The study was conducted in accordance with recognized ethical standards of the Declaration of Helsinki adopted in 1964 and revised in 2013.

We analyzed 6,671 finishes (women's, *n*=1,037, age 36.6±9.1 years; men's, *n*=5,634, 40.0±10.0 years) of 3,881 duathletes. Most duathletes (*n*=2,576) had a single finish, whereas 1,305 duathletes had two to 13 finishes. All analyzes were conducted on data derived from the 'Powerman Zofingen' and the 'ITU Powerman Long Distance Duathlon World Championships'. We examined, the effect of age on pacing (*i.e.,* the relative contribution - % - of each discipline and transition times - Transition 1 and Transition 2 - to overall race time) of duathletes competing either to short (*i.e.,* 10 km Run 1, 50 km Bike and 5 km Run 2) or long distance (*i.e.,* 10 km Run 1, 150 km Bike and 30 km Run 2). Transition 1 and Transition 2 refer to the time spent from the end of Run 1 till the start of Bike, and from the end of Bike till the start of Run 2, respectively, and include mainly the change of clothing and/or equipment.

The race

The 'Powerman Zofingen' is a duathlon event held in Zofingen (Switzerland) within the 'Powerman World Series'. In this race, a short and a long distance version are held. The long distance race of 'Powerman Zofingen' is held since 1997 as the official

Powerman World Championships under the name of 'ITU Powerman Long Distance Duathlon World Championships'. The number of participants in this race is not limited and there is not any qualification criterion.

A duathlon consists of a running part, a cycling part and then again a running part, which are carried out in immediate sequence. Since 2002, the long distance race of 'Powerman Zofingen' has the sequence of 10 km running, 150 km cycling and 30 km running. At the same time of the long distance race, there is a short distance race that includes the sequence of 10 km running, 50 km cycling and 5 km running. Before 2003, the race course and the distances of the disciplines changed several times since the first edition of the race in 1989. Thus, we analyzed all races from 2003 to 2017, i.e. period when there were the same distances for disciplines.

Methodology

Data were obtained from the official race website from 'Powerman Zofingen' www.powerman.ch/de. Race results were sorted by name, age and sex of the finishers separately for both the short and the long distance race. Athletes were ranked in five-year age groups from 15-19 years to 70-74 years and their distribution by sex, age and distance can be seen in **Table 1**. Performance (*i.e.,* relative time) in each discipline (*i.e.,* Run 1, Bike and Run 2) and transition (*i.e.*, Transition 1 and Transition 2) was expressed as a percentage of the total race time using the formula '100×disciplines' time/total time'. We studied relative times of disciplines and transitions instead of actual times, since we considered two duathlons differing for distance and, consequently, for total race times.

Statistical analysis

Data are presented as means±standard deviations. A between-within measures analysis of variance (ANOVA) examined the distance×discipline interaction on relative time, i.e. whether the percentage contribution of each discipline to the total race time varied by race distance. Within each distance, a between-within measures ANOVA examined the sex×discipline and age group×discipline interaction on relative time. A one-way ANOVA examined the main effect of age group on relative time for each discipline separately. The magnitude of these interactions was examined using effect size partial eta square (η^2_p) and was evaluated as following: small ($0.010 < \eta^2_p \leq 0.059$), moderate ($0.059 < \eta^2_p \leq 0.138$) and large ($\eta^2_p > 0.138$) effect estimates (Cohen, 1988). In addition, to analyze the main effects of sex and age group, and their interaction on relative time spent in each discipline and transition (%), a mixed-effects regression model with each finisher as a random variable was used to consider finishers who completed several races. We included ‘sex’ and ‘age group’ as fixed variables in our analysis. Statistical analyses were carried out using GraphPad Prism v. 7.0 (GraphPad Software, San Diego, USA) and IBM SPSS v.23.0 (SPSS, Chicago, USA).

Results

Performance in total and in each discipline (*i.e.,* Run 1, Bike and Run 2) can be seen in **Table 2**. A large discipline×distance interaction on relative time (%) was observed in the short distance race ($F_{(1.425, 9517.786)} = 98000.346$, $p < .001$, $\eta^2_p = .936$); 24.7%, 57.4% and 15.8% was spent in Run1, Bike and Run2, respectively. In the long distance race, the relative contribution of disciplines was 8.0%, 59.0% and 32.1%, respectively. A trivial-to-small discipline×sex interaction on relative time (%) was shown in the short distance run ($F_{(1.611, 5644.023)} = 25.093$, $p < .001$, $\eta^2_p = .007$) and the long distance run ($F_{(1.098, 3481.231)} = 52.095$, $p < .001$, $\eta^2_p = .016$).

In the short distance race, a small discipline×age group interaction on relative time (%) was found ($F_{(19.272, 5609.842)} = 9.402$, $p < .001$, $\eta^2_p = .031$) with athletes in younger age groups spending less time (%) in Run 1, Transition 1 and Transition 2, and athletes in older groups less time (%) in Bike and Run 2 (**Figure 1**).

In the long distance race, a moderate discipline×age group interaction on relative time (%) was observed ($F_{(13.198, 3475.462)} = 22.065$, $p < .001$, $\eta^2_p = .077$) with athletes in younger age groups spending less time (%) in Run 1, Transition 1, Transition 2 and Run 2, and athletes in older groups less time (%) in Bike (**Figure 2**).

In the short distance race, time (%) differed among age groups for Run 1 ($F_{(11, 3489)} = 9.826$, $p < .001$, $\eta^2_p = .030$), Transition 1 ($F_{(11, 3489)} = 30.009$, $p < .001$, $\eta^2_p = .086$), Bike ($F_{(11, 3489)} = 12.186$, $p < .001$, $\eta^2_p = .037$), Transition 2 ($F_{(11, 3489)} = 36.650$, $p < .001$, $\eta^2_p = .093$) and Run 2 ($F_{(11, 3489)} = 2.879$, $p = .001$, $\eta^2_p = .009$). The younger athletes spent relatively less time (%) in Run 1, Transition 1 and Transition 2, whereas the opposite trend was observed in Bike. The magnitude of the age effect ranged from small to moderate, and was the strongest in Transition 2 and the weakest in Run 2.

In the long distance race, time (%) differed among age groups. for Run 1 ($F_{(11, 3158)}$ = 12.290, $p < .001$, η^2_p = .041), Transition 1 ($F_{(11, 3158)}$ = 24.362, $p < .001$, η^2_p = .078), Bike ($F_{(11, 3158)}$ = 29.787, $p < .001$, η^2_p = .094), Transition 2 ($F_{(11, 3158)}$ = 19.081, $p < .001$, η^2_p = .062) and Run 2 ($F_{(11, 3158)}$ = 18.234, $p < .001$, η^2_p = .060). The younger athletes spent relatively less time (%) in Run 1, Run 2, Transition 1 and Transition 2, whereas the opposite trend was shown in Bike. The magnitude of the age effect ranged from small to moderate, and was the strongest in Bike and the weakest in Run 1. The results of the mixed-effects regression analysis of relative (%) and actual times were presented in **Table 3** and **Table 4**, respectively. This analysis highlighted the main effects of sex and age group on relative time (%) spent in each discipline.

Discussion

This study investigated for the first time the effect of age on pacing in athletes competing in two different duathlon distances, short and long, both in the ‘Powerman Zofingen’ held as the ‘ITU Powerman Long Distance Duathlon World Championships’. The most important findings are that (*i*) younger duathletes are relatively (%) faster than their older counterparts in the first run and transitions in short distance race, (*ii*) older duathletes are relatively (%) faster than younger duathletes in cycling in both the short and the long distance race, (*iii*) older duathletes are relatively (%) faster than their younger counterparts in the second run in the short distance race and (*iv*) younger duathletes are relatively (%) faster than older duathletes in the second run in the long distance race.

Younger duathletes are relatively faster in the first run and transitions in the short distance

A first important finding was that younger athletes were relatively faster in the first running discipline in the short distance race. Although young athlete may have an enhanced performance due to physiological causes, this faster first run are probably due to pacing strategy, since older duathletes were faster in cycling and second running leg. Similarly, older marathoners were also faster than younger in the ‘New York City Marathon’ (Nikolaidis & Knechtle, 2017b).

For the aspect of transition times in multi-sports disciplines, very little is known (Rüst, Rosemann, Lepers, & Knechtle, 2014). When athletes competing in 'Ironman Hawaii' were compared to athletes competing in 'Ironman 70.3' between 1998 and

2013, transition times increased for both women and men whereas the sex difference decreased over time. Transition times decreased for both women and men whereas the sex difference remained unchanged in 'Ironman 70.3'. Generally, transition times were slower in 'Ironman Hawaii' compared to 'Ironman 70.3' (Rüst, Rosemann, Lepers, & Knechtle, 2014).

Younger are relatively faster in the second run in the long distance race

A second important finding was that younger athletes were relatively faster in the second running discipline in the long distance race. The second running leg of long distance duathlon comprises 30-km after 10-km run and 150-km cycling. Although older athletes seem to adopt conservative pacing strategies to endure their maximal capacity during the entire race, it is not enough to go faster than younger duathletes. While aging, the human body undergoes several adaptations that decrease the fundamental factors underlying endurance performance, such as running economy and maximal oxygen uptake (Everman, Farris, Bay, & Daniels, 2018; Quinn, Manley, Aziz, Padham, & MacKenzie, 2011).

Quinn et al. (2011) evaluated young, master and older endurance runners in a cross-section design and reported that the main factors affecting performance are maximal and submaximal cardiorespiratory capacity and decreases in strength and power. Many of these detrimental factors to performance may be attenuated in a single race when experienced athletes apply proper pacing strategy, as showed in our short distance results. However, it seems that only proper pacing strategy is not enough to go faster than younger athletes in long distance duathlon.

Older are relatively faster in cycling in both distances

A third important finding was that older athletes were relatively faster in the cycling discipline in both the short and the long distance race. This finding might be due to the age-related performance decline in cycling which occurs later in life than the age-related performance decline in running. When the master World records in 1-h track cycling, 1500-m swimming and 10-km running in athletes older than 60 years were analyzed the maintenance of high performance in cycling persists longer into old age than for running or swimming (Lepers, Stapley, & Cattagni, 2017).

Older are relatively faster in the second run in the short distance race

A fourth important finding was that older athletes were relatively faster in the second run discipline in the shorter race distance. A potential explanation for this finding could be the aspect of experience in pacing with increased age. When marathoners competing in the 'New York City Marathon' between 2006 and 2016 were analyzed, marathoners in older age groups presented a relatively more even pace compared to marathoners in younger age groups (Nikolaidis & Knechtle, 2017b). Similarly for 100-km ultra-marathoners, athletes in younger age groups (*i.e.* 18-24 years) were slower than athletes in most other age groups and athletes in older age groups showed no trend of slowing down (Rüst, Rosemann, Zingg, & Knechtle, 2015). It could also be demonstrated that ultra-marathoners in age group 40-44 years were the best pacers in a 100-km ultra-marathon and were able to achieve a negative pacing in the last segment of the race (Knechtle, Rosemann, Zingg, Stiefel, & Rüst, 2015).

The age-related differences in pacing might reflect differences age-related differences in performance. Duathletes are characterized by high maximal oxygen uptake

(VO_{2max}, 67 $mL.min^{-1}.kg^{-1}$) and large-to-very large correlation between VO_{2max} and race time has been observed (Tong & Rees, 1996). Moreover, aerobic capacity expressed as maximal workload and maximal velocity attained during an incremental exercise test were the best predictors of duathlon performance (Chavarren Cabrero, Jimenez Ramirez, Dorado Garcia, Ballesteros Martinez-Elorza, & Lopez Calbet, 1997). The energy cost of Run 1 and Run 2 are similar (Vallier, Mazure, Hausswirth, Bernard, & Brisswalter, 2003). A study of heart rate responses to duathlon showed similar scores among the three disciplines (Ronconi & Alvero-Cruz, 2011). Since VO_{2max} declines with aging it is reasonable to observe corresponding age-related changes in pacing.

A limitation of the present study was that the findings were specific for the duathlons with similar characteristics as those of 'Powerman Zofingen' and should be generalized with caution to other duathlon races. Strength of the study was that it filled a gap in the existing literature as no previous study examined the age×pacing interaction in duathlon. During the recent years, an increased number of finishers has been observed in 'Powerman Zofingen' (Rüst et al., 2013); thus, our results might impact on increased numbers of duathletes. Coaches and fitness trainers working with duathletes can use these findings to develop age-tailored pacing strategies. It should be also highlighted that the magnitude of age-related differences in pacing in the short distance was stronger in transitions than in the three disciplines. The different trend was observed in the long distance, where the strongest effect of age was shown in the Bike and the weakest in Run 1. Moreover, since the magnitude of age-related differences was stronger in the three disciplines in the long than in the short distance, considering the age of duathletes in designing pacing strategy should be more important in long than in short distance.

Conclusion

In summary, younger duathletes are relatively (%) faster than older duathletes in the first running discipline and in the transition area, whereas older duathletes are relatively faster than their younger counterparts in cycling in both the short and the long distance race. And, older duathletes are relatively faster than younger duathletes in the second run in the short distance race, whereas younger duathletes are relatively faster than older duathletes in the second run in the long distance race. Athletes and coaches should be aware of the variation of pacing by age group and distance of a duathlon race such as ‘Powerman Zofingen’.

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Table 1 Finishes by distance, sex and age group

	Short distance		Long distance	
Age group	Women (*n*)	Men (*n*)	Women (*n*)	Men (*n*)
15-19	24	107	1	2
20-24	49	133	7	70
25-29	100	275	68	271
30-34	108	409	103	444
35-39	99	521	89	511
40-44	89	556	76	541
45-49	56	450	76	394
50-54	25	248	42	235
55-59	6	145	14	124
60-64	0	77	4	59
65-69	0	22	1	32
70-74	0	2	0	6
Total	556	2,945	481	2,689

Table 2 Time (min) spent in disciplines and transitions by distance

	Short distance	Long distance
Run 1	42.9±5.8	40.5±5.2
Transition 1	1.8±0.7	2.1±0.9
Bike	99.7±11.8	299.8±32.1
Transition 2	1.8±0.7	2.7±1.2
Run 2	27.6±4.9	164.1±26.2
Total	174.0±21.6	509.1±59.6

Table 3 Mixed-effects regression analysis of relative time (%) by sex and group

	Short distance			Long distance		
Parameter	Estimate	SEE	Significance	Estimate	SEE	Significance
Run 1						
Intercept	24.03	0.08	<0.001	7.65	0.03	<0.001
Age group	0.12	0.01	<0.001	0.05	0.01	<0.001
Women	0.68	0.19	<0.001	0.18	0.09	0.034
Age group*Women	-0.13	0.04	0.001	-0.01	0.02	0.456
Transition 1						
Intercept	0.82	0.02	<0.001	0.31	0.01	<0.001
Age group	0.04	<0.01	<0.001	0.02	<0.01	<0.001
Women	-0.01	0.04	0.866	0.01	0.02	0.761
Age group*Women	<0.01	0.01	0.585	<0.01	<0.01	0.474
Bike						
Intercept	58.26	0.12	<0.001	60.72	0.15	<0.001
Age group	-0.17	0.02	<0.001	-0.34	0.02	<0.001
Women	0.11	0.29	0.715	1.25	0.39	0.001
Age group*Women	0.06	0.06	0.302	-0.09	0.07	0.178
Transition 2						
Intercept	0.82	0.02	<0.001	0.40	0.01	<0.001
Age group	0.04	<0.01	<0.001	0.02	<0.01	<0.001
Women	-0.06	0.04	0.186	-0.02	0.03	0.607
Age group*Women	0.01	0.01	0.161	<0.01	0.01	0.598
Run 2						
Intercept	16.11	0.08	<0.001	30.94	0.14	<0.001
Age group	-0.04	0.01	0.001	0.24	0.02	<0.001
Women	-0.75	0.19	<0.001	-1.43	0.37	<0.001
Age group*Women	0.06	0.04	0.129	0.11	0.07	0.112

The parameters “Men” and “Age group*Men” interaction are zero because they are redundant. SEE=standard error of estimate.

Table 4 Mixed-effects regression analysis of actual time by sex and group

	Short distance			**Long distance**		
Parameter	Estimate	SEE	Significance	Estimate	SEE	Significance
Run 1						
Intercept	38.81	0.29	<0.001	34.79	0.27	<0.001
Age group	0.65	0.05	<0.001	0.97	0.05	<0.001
Women	6.41	0.72	<0.001	3.28	0.72	<0.001
Age group*Women	-0.50	0.14	<0.001	0.16	0.13	0.203
Transition 1						
Intercept	1.29	0.04	<0.001	1.37	0.06	<0.001
Age group	0.10	0.01	<0.001	0.14	0.01	<0.001
Women	0.18	0.09	<0.001	0.14	0.15	0.325
Age group*Women	<0.01	0.02	0.814	<0.01	0.03	0.934
Bike						
Intercept	93.59	0.65	<0.001	276.64	1.86	<0.001
Age group	0.86	0.11	<0.001	3.86	0.31	<0.001
Women	12.35	1.57	<0.001	26.78	4.84	<0.001
Age group*Women	-0.50	0.31	0.110	0.64	0.85	0.450
Transition 2						
Intercept	1.29	0.04	<0.001	1.77	0.08	<0.001
Age group	0.10	0.01	<0.001	0.17	0.01	<0.001
Women	0.09	0.09	0.326	0.01	0.21	0.978
Age group*Women	0.02	0.02	0.407	0.04	0.04	0.245
Run 2						
Intercept	26.07	0.29	<0.001	139.15	1.56	<0.001
Age group	0.23	0.05	<0.001	4.55	0.26	<0.001
Women	2.11	0.69	0.002	2.32	4.04	0.566
Age group*Women	-0.10	0.14	0.469	1.32	0.71	0.063

The parameters “Men” and “Age group*Men” interaction are zero because they are redundant. SEE=standard error of estimate.

List of figures

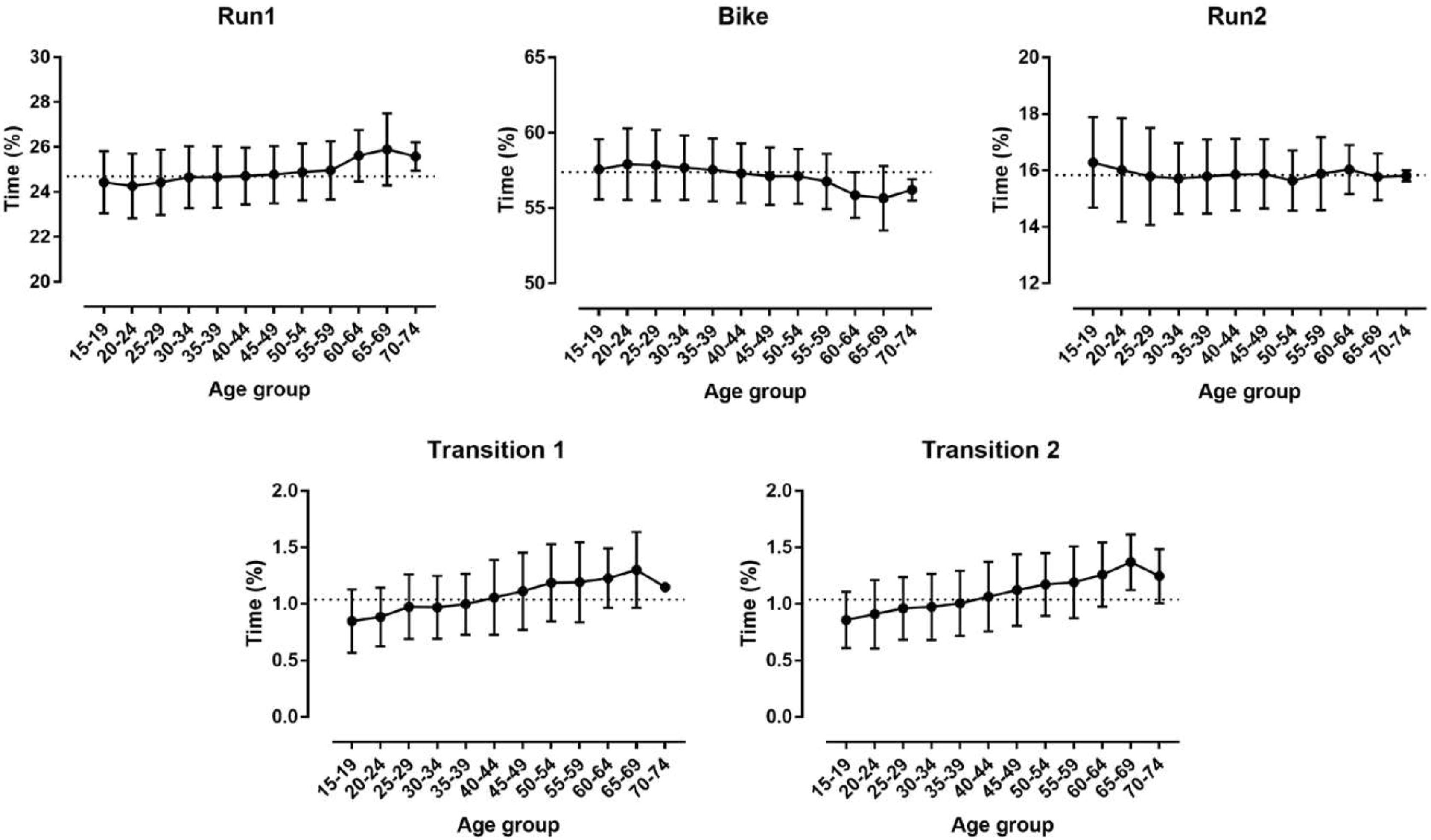
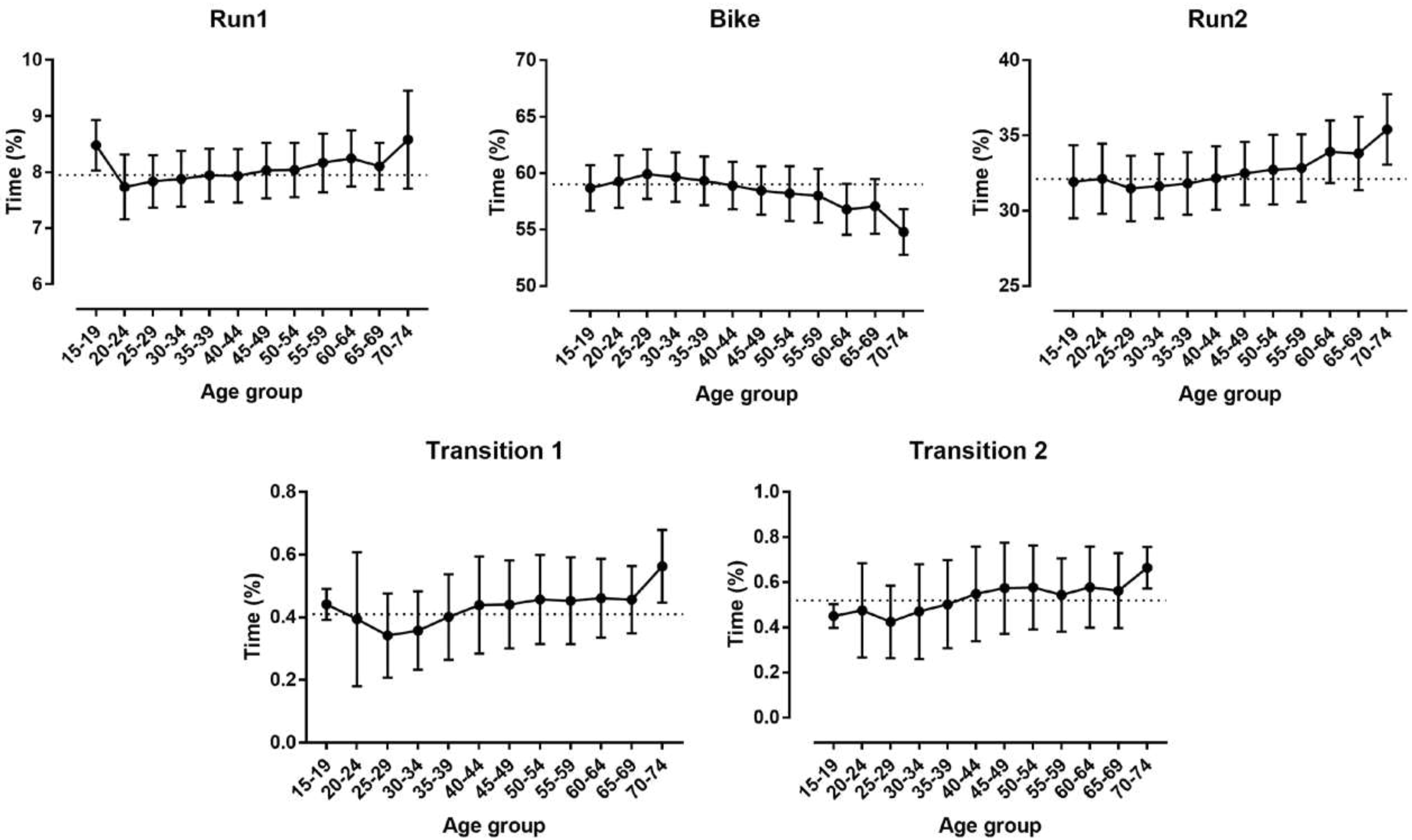

Run1
Bike
Run2
Transition 1
Transition 2
Time (%)
Age group
15-19
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74

Figure 1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15-19
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Figure 2